

# *Traditions of Herbology*

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## ***ABSTRACT***

An overview of healing systems from around the world that make use of medicinal herbs. Modern pharmacognosy, Western holistic herbalism, Chinese medicine and Ayurveda are compared in terms of their philosophy of healing, classification of herbs and disease and preparation of medicinal extracts. Common trends and conclusions among the different traditions tend to confirm the scientific validity of each, and the study of each system can provide the modern health practitioner with a variety of effective modalities for maintaining health.

## **PLANT MEDICINES**

Virtually every culture includes a tradition of healing centered around the expert use of plant products to maintain health, cure illness and heal wounds. In fact, the greatest distinction between established ‘traditional’ healing methods and ‘modern’ pharmacy lies mostly in the level of detail studied and the philosophy toward healing. The results are often quite similar.

Distinctions are often drawn between the ‘Western’ and ‘Eastern’ approaches to healing. These distinctions now are becoming less clear, as ‘modern’ scientific evidence has come to support many of the ‘traditional’ (a.k.a. ‘folk’, ‘esoteric’, ‘hocus-pocus’) healing practices and brought them into the mainstream ‘Western’ paradigm.

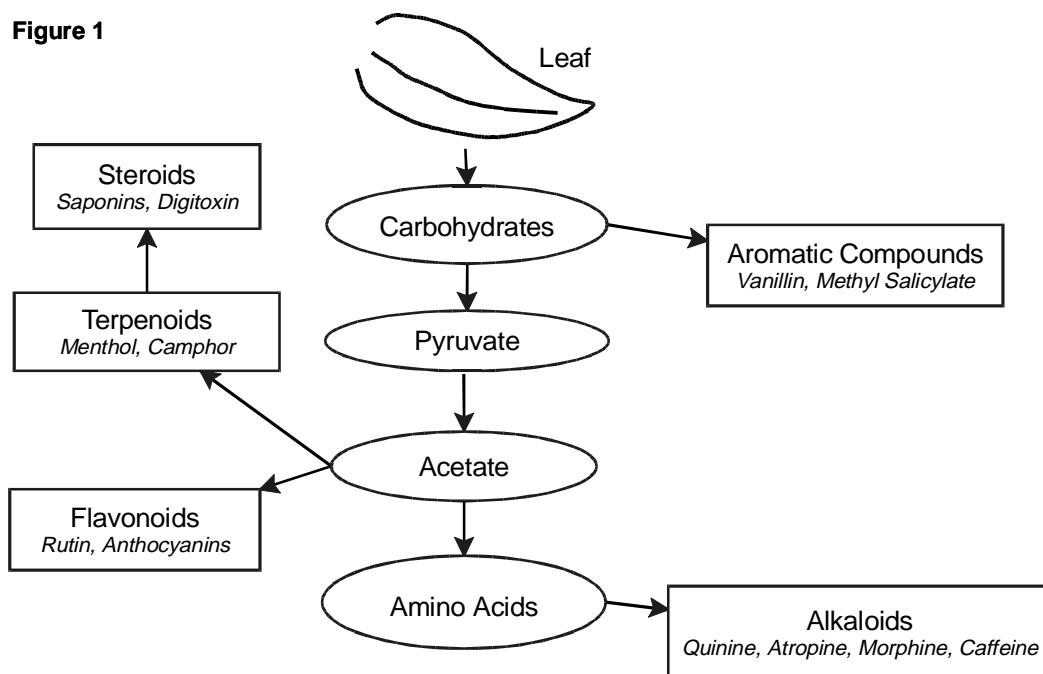
Perhaps a more valid distinction is between the ‘allopathic’ and the ‘holistic’ approaches to healing. In a purely allopathic approach, only the immediate symptoms are considered or treated. For example, a rash would be treated with an ointment to reduce the inflammation. In a holistic approach, the entire patient and his environment are treated simultaneously. In the same example, the patient’s diet, psychological state, hygiene, etc. may all be addressed in addition to treating the immediate symptoms. In fact, neither of these approaches are effective if used exclusively. To continue the example, if the rash was brought on by stress, then applying ointment will not provide lasting relief, but if the rash is caused by poison sumac and is very debilitating, no amount of counselling or dietary changes will replace a good ointment!

In general, the allopathic or symptomatic approach to healing is most effective in treating acute conditions such as traumatic injuries, poisoning, etc. The holistic approach is generally better suited to maintaining good health and preventing the appearance of acute conditions by promoting continual cleansing and support of the body's natural healing and maintenance processes.

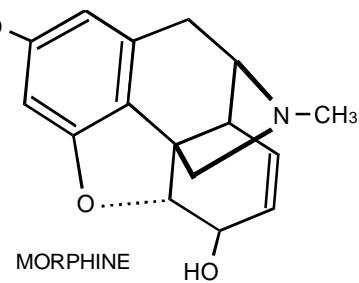
### **ALLOPATHIC HERBALISM - PHARMACOGNOSY**

The term *pharmacognosy* was coined in 1815 by C.A. Seydler to describe "the science which treats of the history, production, commerce, collection, selection, identification, valuation, preservation and use of drugs and other economic materials of plant and animal origin"<sup>1</sup> This broad field generally falls into the Western or allopathic paradigm. Practitioners use advanced methods such as NMR spectroscopy and gas chromatography/mass spectroscopy (GC/MS)<sup>2</sup> to identify and classify active compounds found within plants and animals. Various complex extraction methods are then used to isolate and purify these compounds into potent drugs for specific conditions, such as digitalis from *Digitalis purpurea* (foxglove), atropine from *Atropa belladonna* (deadly nightshade), morphine and codeine from *Papaver somniferum* (opium). These active constituents are also used as a basis for synthesis of more potent or more specific drugs such as local anesthetics based on cocaine, analgesics based on morphine or decongestants based on ephedrine, etc.<sup>3</sup>

Most of these active compounds are classified into the major categories of alkaloids, glycosides (including flavonoids and saponins) and various other volatile compounds.<sup>4</sup> Figure 1<sup>5</sup> gives a very general outline of the pathways by which these major groups are synthesized in plants.

**Figure 1**

The **alkaloids** encompass a wide variety of nitrogen-containing compounds, most of which are highly soluble in methanol, acetone or chloroform.<sup>6</sup> They include some very active compounds affecting the central and peripheral nervous systems, and include some of the most powerful poisons known.<sup>7</sup> Amphetamines, cocaine, opium, morphine, mescaline, caffeine and nicotine are among the best-known alkaloids, however there are also a great many beneficial alkaloids found in traditional medicinal plants, such as the *Aconitum*, *Delphinium* and *Veratrum* species used in traditional Chinese medicine for a wide range of conditions including arthritis, edema, cardiac arrhythmia, high blood pressure, and even cancer.<sup>8</sup>



One aspect of the alkaloids that has remained a mystery to modern researchers is *why* plants produce them, as they seem to serve no vital purpose for the plant apart from playing some role in nitrogen storage. According to W.O. James:

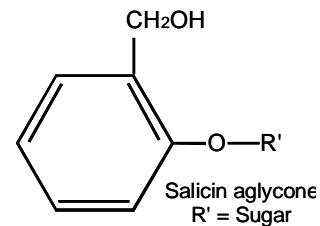
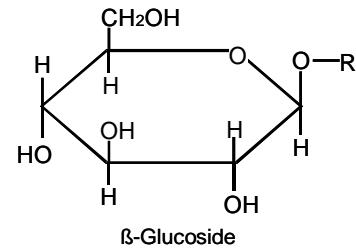
"It is possible to produce a tobacco leaf without nicotine and a belladonna leaf without hyoscyamine, and in neither species do the alkaloid-free leaves differ in any obviously significant way from the normal. Conversely, tomato leaves and fruits containing foreign alkaloids to an extent that might make them dangerous to eat do not develop abnormally"<sup>9</sup>

David Hoffmann, a noted authority in Western holistic herbology, gives a poetic, though perhaps not rigorously scientific explanation for the production of alkaloids:

"...they seem to be provided as a source of healing agents by Gaia [Mother Earth] for humanity and the animal realms through their interaction with the plant realm."<sup>10</sup>

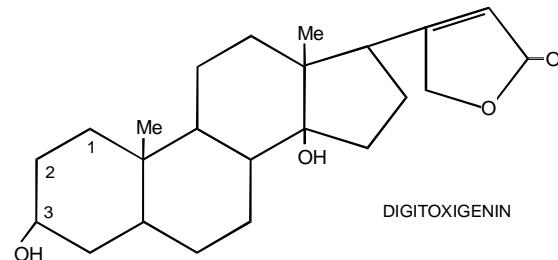
This example accentuates some of the fundamental differences between the rigorous allopathic and traditional holistic healing philosophies. Rather than addressing the possibility that medicinal compounds are produced expressly for our benefit, most modern researchers have been content to leave this question unanswered for the moment and concentrate on the effects of these compounds and their derivatives in humans.

**Glycosides** are derivatives of cyclic sugars in which the reducing or potential aldehyde group (R) of the sugar is substituted by condensation with an alcohol or phenol.<sup>11</sup> Glycosides occur to some degree in all plants, and include many of the pigments of flowers and fruits.<sup>12</sup> They are generally soluble in water, alcohol or acetone, but are not very soluble in ether.<sup>13</sup> When a glycoside is hydrolyzed by enzymes, by dilute mineral acids or by boiling, it yields a sugar and an organic residue called the aglycone,<sup>14</sup> which is the part



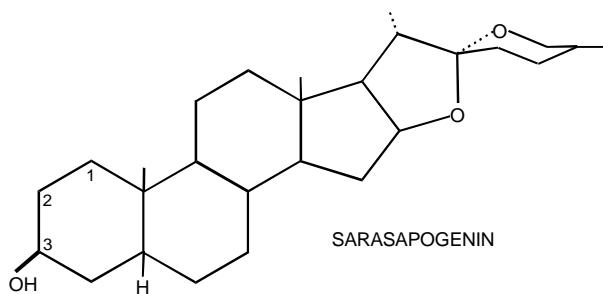
that primarily determines the medicinal action of the glycoside. The sugar portion of the molecule is believed to help determine its solubility in water, and thus the absorption by the body.<sup>15</sup>

One particularly well-known group of glycosides are the **cardiac glycosides**, stemming from foxglove (*Digitalis purpurea*) and plants in a few other orders. Although the plants are generally considered to be deadly poisons, extraction and purification of these glycosides in which Digitoxigenin or a similar aglycone may be attached (at carbon number three) to any of a variety of sugar components,<sup>16</sup> have led to a powerful family of drugs used with cardiac patients to slow heart rate while at the same time increasing cardiac efficiency. As a relatively simple example of the modern methods used to extract a desired compound from its natural source, R.J. McIlroy describes the following procedure:



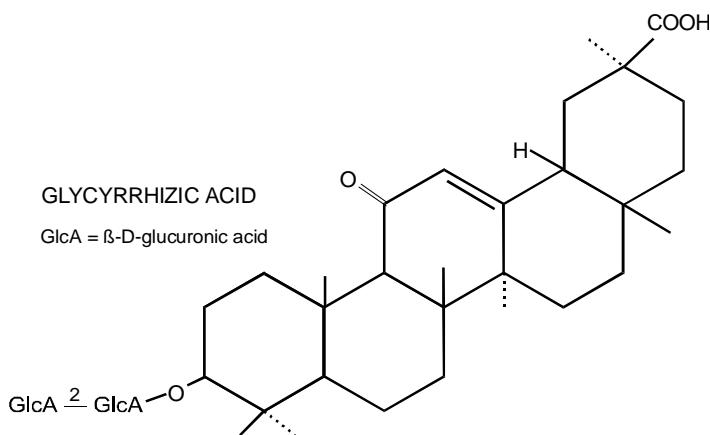
"In the extraction of the cardiac glycosides from *Digitalis lanata* the leaves are kneaded with magnesium oxide and a little water and the mass extracted with organic solvents such as ethyl acetate or acetone. Pre-treatment of the dried leaves with benzene or other hydrocarbon solvent to remove fats and resins is frequently adopted. The solvent extract from the magnesium oxide treated leaves is evaporated, dissolved in aqueous alcohol, and shaken with ether to remove tars. The glycosides crystallize from the aqueous alcohol layer and are recrystallized from acetone or aqueous dioxan."<sup>17</sup>

Another important group of glycosides are the high molecular weight **saponins**, which consist of a sugar linked to a triterpene or steroid aglycone.<sup>18</sup> As their common names imply, herbs such as soapwort (*Saponaria officinalis*), soaproot (*Chlorogalum*

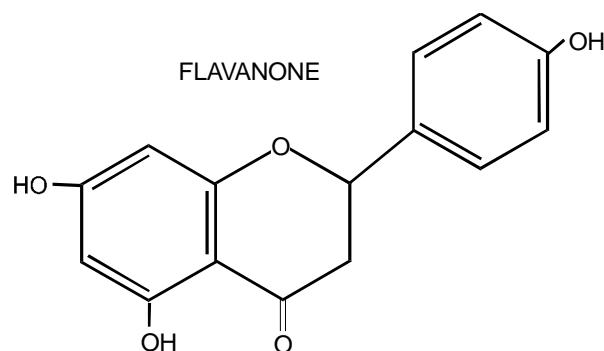


*pomeridianum*) and others have been used traditionally in soaps,<sup>19</sup> but many other herbs also contain important saponins. Sarsaparilla (*Sarsaparillae radix*) yields sarasapogenin and its derivative parillin, which has been shown to exhibit activity against *Staphylococcus aureus*, *Escherichia coli* and many fungi, explaining its traditional use against many bacterial and fungal disorders, including leprosy.<sup>20</sup> Sarsaparilla saponins also enhance the resorption of substances in the digestive tract; the herb can thus be added to other drugs to increase their bioavailability.<sup>21</sup>

Licorice (*Glycyrrhiza glabra*) contains the sweet tasting glycyrrhetic acid, which has been shown, both traditionally and clinically, to be a highly effective expectorant, and actually capable of curing various ulcers. Glycyrrheticin has also demonstrated effectiveness against the growth of certain tumors, most especially in the liver.<sup>22</sup> Derivatives of glycyrrheticin have also recently been found to have anti-viral activity against some DNA and RNA viruses, including herpes simplex 1, polio virus 1 and HIV-1.<sup>23</sup>



The **flavonoids** are another important group of closely related plant pigments derived from flavanone, which is formed by condensation synthesis of acetate and phenylalanine molecules.<sup>24</sup> These compounds are found in various citrus plants and other herbs, such as licorice, thyme (*Thymus vulgaris*) yarrow (*Achillea*



*millefolium*) and others.<sup>25</sup> These compounds have demonstrated anti-bacterial and anti-fungal properties,<sup>26</sup> and appear to play a role in stabilizing cell membranes and regulating or inhibiting the histamine reaction, thus preventing acute inflammation.<sup>27</sup> This may help to explain the traditional use of herbs like yarrow in the treatment of wounds. Flavonoids have also been shown to increase skin capillary resistance, preventing blood vessel damage.<sup>28</sup> Flavone acetic acid and (+)-catechin are among the flavonoids under study for their anti-tumor and anti-invasive properties in the treatment of certain cancers.<sup>29 30</sup>

In the broad, and somewhat miscellaneous, category of **volatile oils** are compounds found in herbs such as lavender, peppermint, rose petals, etc. which are utilized in aromatherapy to stimulate or tranquilize the nervous system<sup>31</sup> or applied externally to increase blood flow.<sup>32</sup>

## **HOlistic HEALING**

There are many distinct healing schools that fall under the broad category of 'holistic.' Most prominent among these are Western traditional (folk) medicine, Chinese medicine and India's Ayurveda. The basic premise of all of these systems is to promote 'balance' or 'harmony' among the constituents of the body. The basic assumption is that the body 'wants' to be healthy, that health is the natural state of the body and that the body is normally equipped to remain healthy.

## **WESTERN HOlistic HEALING**

In the *New Holistic Herbal*, David Hoffmann writes:

"The promotion of health and the prevention of disease is a priority, whilst emphasis is placed on the responsibility of each individual for his or her own health. The therapeutic approaches employed are aimed at mobilising the person's innate capacity for self-healing."<sup>33</sup>

The Western Holistic or folk medicine paradigm treats the body in terms of systems: nervous, digestive, respiratory, reproductive, muscular, skeletal systems, etc. all cooperating harmoniously in a state of health. A dis-ease condition is viewed as a weakness or wearing-down of organs in one or more of these systems, and medicines are therefore directed at ‘tonifying’ or strengthening individual organs or entire systems. Herbs are viewed in terms of their ‘actions’ on these organs and systems.



For example, *The New Holistic Herbal* lists the common dandelion (*Taraxacum officinale*) as a *diuretic*—meaning that the herb promotes body-wide cleansing through increased urination, a *cholagogue*—stimulating the activity of the gall-bladder, an *anti-rheumatic*—easing the effects of rheumatism, a *laxative* and a *tonic* to the liver and urinary tract—suggesting that the herb specifically nourishes and strengthens the functions of these tissues. This herb is therefore recommended both in treating diseases of the urinary and digestive systems, and in conditions where fluid has built-up in bodily tissues and increased excretion is helpful: Water retention and some forms of rheumatism, for example.<sup>34</sup>

Licorice is described as an *expectorant*—which helps to remove excess mucus from the body, a *demulcent*—able to soothe and protect irritated internal tissues, *anti-inflammatory*, *laxative* and *anti-spasmodic*—easing spasms or muscle cramps in the body.<sup>35</sup>

Western herbology describes several methods for preparing plant-based medicines. The two most prominent methods are the *decoction* and *infusion*. In a *decoction*, roots, barks or seeds are simmered in water for ten to fifteen minutes to help break down the cell walls and release the active constituents

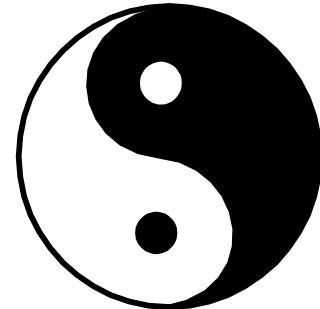
into the water. An *infusion* is used for leaves and flowers, and when the desired compound is volatile or heat sensitive. The herbs are steeped in hot or cold water or milk just as one makes tea. An advantage of using warm or cold milk instead of water is that milk contains fats and oils that help to solvate the oils present in the plant material.<sup>36</sup>

*Tinctures* are extractions using alcohol or glycerine. Alcohol, being a less polar solvent than water, tends to extract more active constituents—most of which contain C-OH bonds as illustrated in the previous sections. Alcohol also acts as a natural preservative of the resulting tincture. Glycerine is considered to be in-between alcohol and water in its effectiveness as a solvent, and is milder on the digestive tract than alcohol.<sup>37</sup>

Herbs containing volatile oils, such as the mints and camphor, are sometimes infused in light vegetable or nut oils for external use in massage or as ointments. *Essential oils*, where the active components have been extracted by fractional or steam distillation are now commercially available and are used in place of fresh herbs where they are not readily available.<sup>38</sup>

## **CHINESE HERBALISM**

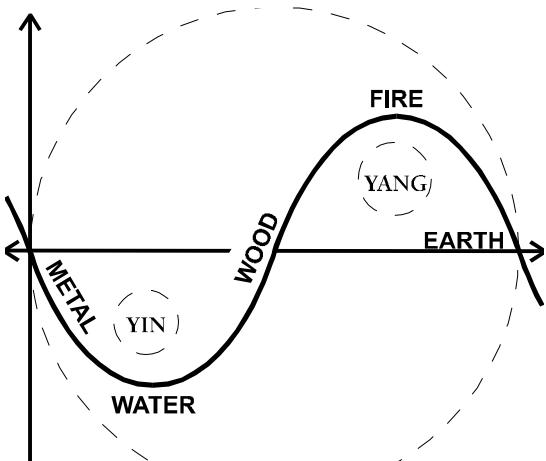
Traditional Chinese medicine represents a drastically different approach to the human body, health and herbs. Although modern physics has just recently become open to the conception that matter is actually a complex interaction of energy, and that matter and energy can be interchanged, the ancient Chinese healing arts have taken this principle for granted for thousands of years. Central to these healing methods is the conception of life energy, or Chi, which flows through all living things. Chi flows throughout the body along distinct paths, called meridians, which form connections between organs, and an interface between the inside and outside of the body.<sup>39</sup> Although the conception of Chi



was initially scoffed-at by Western scientists, the unexplainable effectiveness of healing systems such as acupuncture have led modern researchers to seriously investigate the meridian system. For example, in the mid-1970's, research into the nature of acupuncture anesthetic and analgesic points led to the discovery of the endorphins and enkephalins, natural opiates produced by the body in response to pain and emotional stress.<sup>40</sup> A great deal of research is now dedicated to "bio-fields" and bio-electric phenomena, essentially based on the traditional Chinese teachings.<sup>41</sup>

The nature of Chi is often shrouded in mystery, however it is not at all mystical. It simply stands to reason that if a body can at one moment be 'alive,' and at another be 'dead,' that some real, significant change has occurred—something has left the body, although the chemical composition of the body may not have changed significantly. The ancient healers describe that 'something' as Chi.

The motion of Chi is described in terms of the polarity principle of Yin and Yang. Although often misunderstood as "opposites" (positive/negative, black/white, male/female, etc.), a better analogy is to potential (Yin) and kinetic (Yang) energy. Just as a mass on a string tends to follow a cyclic pattern of potential energy storage and kinetic energy release, Chi is said to cycle perpetually between the Yin state wherein energy is collected, and the Yang state where it is released. Every process in nature is said to exhibit this principle. For example, water evaporates from the Earth's surface and collects into a cloud (Yin stage). When the cloud accumulates water to its full capacity, the water is released as rain (Yang stage) and the process repeats.<sup>42</sup>



The cyclic process is further broken down into five stages, referred to as the five elements: Water, Wood, Fire, Metal and Earth. These essentially describe points along the transition, as illustrated at left. Water represents the completely Yin stage, where all energy is stored (potential). Wood represents the transformation from energy storage to motion, Fire represents pure Yang (kinetic) energy, and Metal represents a drawing inward and storage in preparation for return to the Yin stage. Earth represents the center and balance, and may be viewed as the nodes of the curve in the diagram.<sup>43</sup>

Chi naturally cycles between the Yin and the Yang states as it moves through the body, much as in alternating current, where electric charges move from a positive to a negative polarity as they travel along a wire. In the study of electrical transmission lines we see that although the electric charges are continuously moving, there are regions of the transmission line where the ‘standing wave’ is always in a positive state, regions where it is always in a negative state, and nodes which appear stationary. The motion of Chi through the body is analogous to standing waves, and subsequently there are regions of the body that are said to be primarily Yin or Yang in nature, and further that some areas are “dominated” by different elements.

Chinese healers do not view the body in terms of organs and systems quite the way Western healers do, either. Instead, the “energy system” of the body is composed of twelve primary “organ-meridian” systems, each of which controls a broad range of related physiological processes<sup>44</sup> and, in a simplified sense, is analogous to a transmission line. Certain regions and organs are designated as Yin, and some as Yang by nature. For example, the Lung meridian is a Yin organ dominated by Metal. In addition to the breathing, the

Lung meridian controls cellular respiration, skin tone, opening and closing of the pores, sweating, shivering, voice and sense of smell. In addition, it is said to help regulate the autonomic nervous system by control of the breath.<sup>45</sup>

When the natural movement and cycling of Chi is disturbed, or a meridian becomes “blocked” by some external influence, the resulting imbalance manifests as physical weakness or illness. In this case, healers use techniques of acupuncture, massage and herbology to restore proper flow.

Actually, the primary use of herbs in Chinese medicine is in tonics that are taken regularly to maintain a strong, healthy flow of Chi and prevent illness from occurring in the first place. Herbs are either cooked into soups or otherwise used in cooking so that the meridians are constantly being cleansed and nourished.

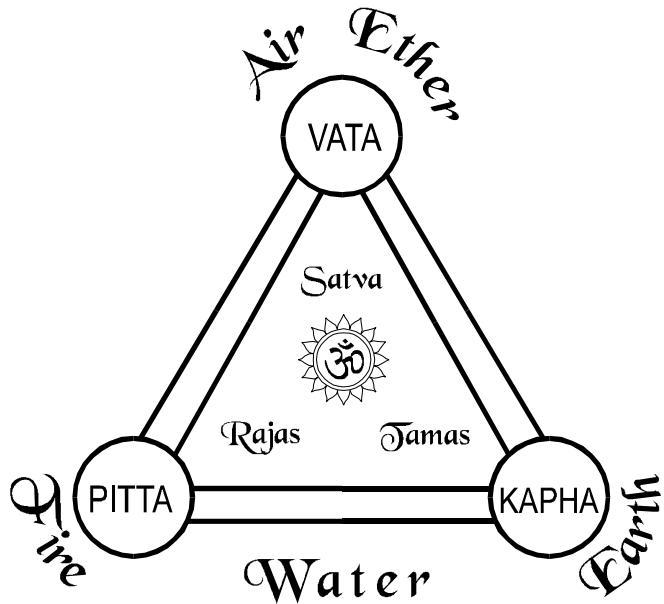
Medicinal plants are classified by their energy (warm/cold, wet/dry) and their flavor, which indicates the element that dominates the plant. For example, plants dominated by the Metal element have a pungent or spicy flavor (e.g. ginger, cinnamon). The connection is then made that herbs dominated by a particular element affect the organ-meridians dominated by the same element, in this case the Lung and Large Intestine meridians.<sup>46</sup> This can be seen to correlate with Western herbology, where ginger and cinnamon are known to stimulate digestion and help clear excess mucous.<sup>47</sup> Licorice is said to have a sweet flavor, dominated by Earth, which suggests that it will be tonic to the Spleen-Pancreas and the Stomach meridians, which are also dominated by Earth.<sup>48</sup> This is also confirmed by Western holistic and allopathic systems, as described in previous sections.

## AYURVEDA

The Ayurveda contains the oldest recorded tradition of healing known. It is an integral part of the texts known collectively as the Vedas, which were considered ancient texts even at the time the Bhagavad-gita was written, over five-thousand years ago.<sup>49</sup> While a great deal of this original knowledge has been lost and distorted over the centuries, the roots of this system have been perpetuated—Ayurveda is still practiced throughout India, and continues to gain popularity throughout the world.<sup>50</sup>

The Vedic conception is truly holistic: The entire material creation is viewed as being made up of five elements: Ether, Air, Fire, Water and Earth. These elements interact based on three modes, known as: *sattva*, *rajas* and *tamas*, which are commonly translated as *goodness*, *passion* and *ignorance*, although a great deal is lost in this translation.

The word ‘element’ holds a different meaning in the Vedas than in modern science. The modern conception is that all matter is made up of specific combinations of discrete elements... Hydrogen, Carbon, Oxygen, etc., which in turn are made up of more ‘elemental’ elements, namely protons, neutrons and electrons. Modern physics has gone even further to say that these particles are actually made up of smaller subatomic particles, which themselves are made up of smaller particles, etc., etc. The search goes on for the tiniest, most elemental set of elements that are the ‘real’ building blocks of nature.



The Vedas explain that all matter is made-up of all five elements taken together, under the influence of the modes of nature. In other words, the five elements never occur individually, and cannot be separated. The actual nature of the elements is somewhat obfuscated by their translations as Ether, Air, etc. The element known as Ether can also be viewed as “empty space,” as in the completely vacuous space between the nucleus and the electron of an atom. Air can be thought of as motion, and Fire as heat. Water is somewhat more abstract, but is analogous to viscosity, and Earth represents solidity or substance. With these slightly less cryptic translations, we can indeed see that everything in nature is constructed with some open space (Ether), and that everything vibrates with some degree of motion (Air), generating heat (Fire), which flows from higher temperatures to lower just as water flows downhill. All motion has some inherent degree of “fluidity” (Water), and all matter has substance (Earth).

The modes of nature are essentially the “rules” by which the elements interact and combine to form the great diversity found within nature, and as such are understandably somewhat complex. The Bhagavad-gita explains the modes through numerous examples and analogies, such as the following categorization of foodstuffs:

“Foods in the mode of goodness increase the duration of life, purify one’s existence and give strength, health, happiness and satisfaction. Such nourishing foods are sweet, juicy, fattening and palatable. Foods that are too bitter, too sour, salty, pungent, dry and hot, are liked by people in the modes of passion. Such foods cause pain, distress and disease. Food cooked more than three hours before being eaten, which is tasteless, stale, putrid, decomposed and unclean, is food liked by people in the mode of ignorance.”<sup>51</sup>

The Ayurvedic practitioner evaluates patient, disease and cure all in terms of these principles. Diagnosis is usually done in terms of the *doshas*, which are essentially extreme combinations against which matter can be measured. *Vata dosha* is the combination of Ether and Air—it’s characteristics

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are light, dry and cold. *Pitta* dosha is a combination of Fire and Water—it's characteristics are light, oily and hot. *Kapha* dosha is a combination of Water and Earth—its characteristics are heavy, oily and cold.

Thus, a person of large stature and soft skin who tends to move slowly would be considered extremely *kapha*, while someone who is emaciated, with rough skin and poor circulation would be extremely *vata*. Again, the doshas never actually occur alone—everyone actually falls somewhere within these extremes. Emotional states can also be viewed in this context, with anger or jealousy falling into the extreme *pitta* category, restlessness and nervousness in the *vata* category, and cheerfulness in the *kapha* category.<sup>52</sup>

Plants are also categorized by dosha. Thus a plant such as *aloe vera* is considered to ‘normalize’ *kapha*, and cayenne pepper increases *pitta*. Some herbs, such as haritaki (*Terminalia chebula*), ginseng (*Panax ginseng*), and gotu kola (*Hydrocotyle asiatica*) are considered to have an equalizing effect, adaptively rebalancing the doshas.<sup>53</sup> A strong, intricate correlation exists between the appearance and taste of herbs and their activity on the doshas.<sup>54</sup> Licorice is said to be sweet and slightly bitter, with a cooling energy. It thus reduces *vata* and *pitta* which suggests it will work well in the treatment of *pitta* conditions such as ulcers, When decocted in milk, licorice ‘liquefies’ *kapha*, increasing its Water properties and thus helping to clear heavy mucous from the body as an expectorant and laxative.<sup>55</sup>

Disease is also analyzed in terms of doshas. A dry, burning rash, for example, would be analyzed as a local imbalance of *pitta* and *vata*, for which the practitioner would attempt to rebalance *kapha*—perhaps with *aloe*.

Numerous techniques for preparation are described in the Ayurveda. The five primary methods are fresh juice, mashed paste (used externally), decoction, hot infusion and cold infusion. Milk decoctions are much more favored than in Western herbalism. Extractions are also made into clarified

butterfat (*ghee*) and taken with food, or into tree resins such as guggul (*Commiphora mukul*) and formed into pills. Sesame oil is preferred for applying the herbs to the skin, nose or ears. Preparation methods are also described using various metals, such as gold, silver, copper and mercury, however these can be highly toxic if not prepared correctly, and are not recommended for the novice.

As in Chinese herbology, the primary focus of Ayurveda is on the promotion of good health and avoidance of disease. Extraordinarily detailed instructions are given for diet, lifestyle and personal hygiene that are intended to keep the body properly nourished, clean and healthy. A strict vegetarian diet is recommended, not only because of the spiritual and psychological implications of mass animal slaughter, but also because decaying flesh definitely falls into the 'putrid, decomposed and unclean' category mentioned above as conducive to the mode of ignorance. Modern science is gradually catching-up with this lesson also, as intestinal and colo-rectal cancers are increasingly linked to high-meat diets.<sup>56</sup>

"You do not need medicine if your diet is right, and it's not medicine you need if your diet is wrong."<sup>57</sup>

Many of the spices associated with Indian cooking, such as ginger, cinnamon, cardamom and cloves are intended to promote strong digestion and internal cleansing. Thus each meal is, in effect, a trip to the doctor.

**CONCLUSIONS**

The major healing philosophies presented here reflect great cultural diversity and millennia of careful scientific study and development. In elucidating some of the basic theories underlying these methods we have seen how vastly different philosophies and techniques can often come to the same conclusion, thus reinforcing the validity of all of these scientific processes. As we traced licorice, an herb common to all of the systems examined, we have seen that many different labels have been applied to explain its function, but each system comes to the same basic conclusions about its activity.

The systems have essentially been presented in order, from the most recently developed methods to the most ancient, but all are still in thriving practice around the world. The inherent strengths of each of these systems, whether by indicating the optimal diet for a patient's particular constitution, or by transforming the poisonous foxglove into beneficial heart medication, offer important diagnostic and therapeutic tools to the modern health practitioner.



## NOTES

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<sup>1</sup> Youngken; *A Text Book of Pharmacognosy*; 1943; p3.

<sup>2</sup> Kruter, M.H. et al.; *Analysis of the Terpenes of Gingko Biloba by HPLC and GC/MS*; Plant Medica; 1993; p633.

<sup>3</sup> Der Marderosian; *Natural Product Medicine*; G. F. Stickley Co.; Philadelphia; 1988; pp3-4.

<sup>4</sup> Flück, Hans; *Medicinal Plants: An Authentic Guide to Natural Remedies*; W. Foulsham & Co.; London; 1988; pp8-12.

<sup>5</sup> Der Marderosian; *Natural Product Medicine*; p14.

<sup>6</sup> Manske; *Sources of Alkaloids and their Isolation*; Manske, Ed.; The Alkaloids: Chemistry and Physiology; Academic Press, Inc.; New York; 1949; p11.

<sup>7</sup> Flück, Hans; *Medicinal Plants*; p11.

<sup>8</sup> Han, Gui-Qiu et al.; *Distribution of Alkaloids in Traditional Chinese Medicinal Plants*; Brossi, A. Ed.; The Alkaloids Vol. 32; Academic Press, Inc.; San Diego; 1988; pp241-270.

<sup>9</sup> James, W.O.; *Alkaloids in the Plant*; Manske, Ed.; The Alkaloids: Chemistry and Physiology; Academic Press, Inc.; New York; 1949; p16.

<sup>10</sup> Hoffmann, David; *The New Holistic Herbal*; Element Press; Shaftsbury, Dorset; 1990; p140.

<sup>11</sup> McIlroy, R.J.; *The Plant Glycosides*; Edward Arnold & Co.; London; 1951; p1.

<sup>12</sup> Ibid. p5.

<sup>13</sup> Ibid.

<sup>14</sup> Ibid.

<sup>15</sup> Flück, Hans; *Medicinal Plants*; p9.

<sup>16</sup> McIlroy, R.J.; *The Plant Glycosides*; Edward Arnold & Co.; London; 1951; p79-84.

<sup>17</sup> Ibid. p79.

<sup>18</sup> Hostettmann, K. et al.; *Saponins*; Cambridge University Press; 1995; p1.

<sup>19</sup> Ibid.

<sup>20</sup> Ibid, p312.

<sup>21</sup> Ibid.

<sup>22</sup> Ibid, p312-316.

<sup>23</sup> Ibid, p317-318.

<sup>24</sup> Ebel, J. et al.; *Biosynthesis*; Harborne et al., Ed.; The Flavonoids: Advances in Research; Chapman & Hall; London; 1982; pp648-649.

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<sup>35</sup> Ibid, p211.

<sup>36</sup> Ibid, p151.

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<sup>38</sup> Ibid, p164.

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<sup>42</sup> Ibid, p34.

<sup>43</sup> Ibid, pp43-44.

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<sup>45</sup> Ibid, pp63-64.

<sup>46</sup> Ibid, p54.

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